

scription of it is not given until p. 276, where no reference to the foregoing figure occurs. The same dislocation of figures occurs in many groups.

(2) Mr. Crawford is an impressionist, and one who shares the Wordsworthian spirit. In these slight word-pictures of east-coast scenery he sketches, in a very dainty and observant fashion, the picturesque features of animal life as seen against the varying background of nature's moods. He believes, and reiterates his belief in, the value of our response to such beauty. He is an artist.

"We think in pictures. We recall in pictures. We remember more than we see. With this aid, to evolve our artistic sense were easy, to add a touch of imagination were not hard. Thus, simply, might the world be made to seem beautiful and life be filled with gladness."

These essays will perhaps not add to Mr. Crawford's reputation, but they will certainly not detract from it.

(3) This little book is mainly a reprint of articles on the geology of Melbourne and neighbourhood contributed to the *Melbourne Argus*, but also includes a survey of the strata round Port Phillip Bay and up country to Ballarat and Bendigo. The bedrock, of Silurian age, is characterised by rough, dark-barked gum-trees, and is economically of great importance for the making of pottery and bricks. The wearing down of this rock has produced the gravel beds in which the gold of the bedrock is found. These gravel beds have also their characteristic flora, the grass-trees. Intersecting these are granitic rocks which have weathered out, and support a flora of native cherries, white-barked gums, and other trees. The vast blue-stone plains have been formed by eruptions of lava emerging through the bedrock, and are distinguished by their grassy, treeless appearance. In addition there are glacial beds in many districts, and cinder beds in a few others, supporting dense forest and forming rich farm land. The descriptions are very clear, and are illustrated by good photographs.

ELECTROMAGNETIC THEORY.

(1) *Anfangsgründe der Maxwell'schen Theorie, verknüpft mit der Elektronentheorie.* By Franz Richards. Pp. ix+245. (Leipzig: B. G. Teubner, 1909.) Price 7 marks.

(2) *The Theory of Electrons, and its Applications to the Phenomena of Light and Radiant Heat.* By H. A. Lorentz. Pp. iv+332. (Leipzig: B. G. Teubner; London: David Nutt and Williams and Norgate, 1909.) Price 8 marks.

(1) THE first of these volumes deals with the foundations of Maxwell's electromagnetic theory. The author is careful to point out that it is not a text-book, but a sketch based on lectures delivered to teachers. For this reason the treatment differs somewhat from what may be regarded as the normal method of presenting the subject to students; although in a branch of physics which appeals to a comparatively limited class, it may be doubted whether there are satisfactory grounds for introducing preferential treatment.

At an early stage the author shows how the two fundamental "circuital relations" are connected by means of the principle of least-action. This is an excellent feature, and the proof would probably have produced greater impression had some definite physical picture, such as that adopted by Larmor, been introduced.

In succession, the author treats of static effects in non-conductors, of conduction, and of magnetic effects of currents. The introduction of Stokes' theorem, which is delayed until this stage, might, with advantage, have been introduced much earlier.

Induction is next discussed, and finally there is a chapter on electromagnetic waves, which closes with a brief and rather imperfect treatment of metallic reflexion.

As a whole the book is somewhat disconnected, but it ought to be judged as a collection of monographs, and from this point of view the treatment is clear and good.

(2) Lorentz' book deals with the latest development of the electromagnetic theory. It contains a series of lectures delivered in Columbia University, New York, in 1906, and will be welcomed as his latest views on a subject which owes its origin and much of its development to Lorentz himself.

There are five chapters and a section of notes, which give calculations too elaborate to be included in the text. Chapter i. treats of general principles and the doctrine of free electrons. It is to Lorentz that we owe the view that the free æther is to be regarded as at rest, and that hence phenomena in it are governed by the two "circuital" and the two "solenoidal" equations of Maxwell.

At discrete points we may have electrical singularities characterised by a certain density. The effect of this at those points is simply to make the electric divergence equal to the density, instead of nil, and to add to the displacement current, a portion due to convection of amount equal to the product of density and velocity. At other points in the æther the effects are sufficiently included in the four fundamental equations. It is of importance to notice that this specification imposes a limitation on the internal character of an electron. Thus if an electron is defined as a shell with a surface charge of electricity, its interior must, on the basis of Lorentz' equations, consist of nothing but æther. The limitation carries important consequences, such as prescribing surface conditions.

In this chapter the author discusses the question of electric inertia on the basis of Kaufmann's experiments; but as he again takes up the question more fully in a later chapter, it will be convenient to reserve our observations.

Chapter ii. is devoted to the question of radiation and absorption of heat. Those who have followed the interesting discussion on this matter in the *Physikalische Zeitschrift* recently, will not be surprised to find that Lorentz devotes some space to the question whether the æther and the radiating body, supposed to consist of electronic radiators, can be regarded as a system to which the law of equipartition of energy can be applied. The result of such an assumption is in flat contradiction to observation. As

the law of equipartition has never been proved for purely dynamical systems, and is probably not in general true, it is not surprising that it fails when applied to the æther.

The Zeeman effect is discussed in chapter iii., and the author is chiefly concerned in showing how little progress has been made in elucidating the phenomena, and how much knowledge of atomic structure we may reasonably hope to gain from study of the facts.

The electron theory of dispersion is next dealt with. Probably most readers will regret that the author has not found it possible to enter more fully on the problem of the optical properties of metals.

Optical phenomena in moving bodies forms the subject of the last chapter. The explanation of Fresnel's hypothesis on an electromagnetic basis is one of the most important results contributed by Lorentz to optical theory. The explanation of the result of the Michelson-Morley experiment and of the double refraction experiment by Lord Rayleigh and Brace, forms most interesting reading. The hypothesis of a contracted electron is introduced, and with it the question of electric inertia is again raised. The chapter closes with an exposition of Einstein's principle of relativity.

The book is a most fascinating one, and to those acquainted with Lorentz' former memoirs, it is unnecessary to say that it is written with a lucidity that characterises a master hand.

We venture to offer some observations on the view that negative electrons possess an inertia which is entirely of electric origin. It appears to us that the proof requires considerably more support, both on the experimental and on the theoretical side, than it has yet received.

For many purposes it is unnecessary to define an electron further than to say that it possesses a charge. But when we come to the question of inertia we have to define the size and shape of the electron. Surface conditions are, of course, determined by the fundamental equations. We confine attention to the two cases considered by Lorentz, viz., the "rigidly" electrified sphere of Abraham and the contracted electron of Lorentz. It has been claimed that Kaufmann's experiments agree with the spherical electron formula and the view that the ordinary inertia is *nil*. As a matter of fact, his experiments agree very much better with the contracted electron formula, but make the ordinary inertia quite comparable with the electric inertia for slow speeds. Bucherer's experiments also agree with the contracted electron formula, and make the ordinary inertia *nil*, but the speed was not so high as in Kaufmann's experiments. On the theoretical side it must be remembered that both formulæ are derived from the energy of the steady state, using the "quasi-stationary state" principle. This principle has been acknowledged as quite unsound, and it must in general lead to false results, when, as in the present case, any change of velocity is attended with radiation into the medium. We have reason to believe that any change of velocity is accompanied by a redistribution of the charge on the electron, and this in general leads to an expression for the inertia which

differs from that obtained by differentiating the energy of the steady state.

We may well hesitate to sweep away the last scrap of ordinary matter from an electron until the proof rests on some principle more convincing than that of the quasi-stationary state.

OUR BOOK SHELF.

Handbook of Marks on Pottery and Porcelain. By W. Burton and R. L. Hobson. Pp. xii+210. (London: Macmillan and Co., Ltd., 1909.) Price 7s. 6d. net.

THIS volume supplies a distinct want. Mr. Burton is a practical potter, and the author of numerous works on the history of pottery and porcelain. Mr. Hobson is on the British Museum staff, and there are few men with greater chances of seeing and studying examples of all periods of pottery. The authors, therefore, speak with authority on subjects connected with ceramics, and although they style it a "reliable pocket volume," it is really a valuable and interesting addition to the bookshelves of collectors and students of pottery. Thousands of authentic marks will, of course, not be found in the volume, but those chosen are, on the whole, thoroughly representative, and the elaborate indices make the work of reference easy.

It is interesting to note the influence that one factory had on another, as shown by the marks. The Meissen factory was the father of European porcelain. The Cross Swords from the arms of Saxony, which was used there as their mark, can be seen in Caughley Tournay, Worcester, Derby, and Bristol. Even Meissen itself had in its early days, like so many other factories, marks in imitation of the oriental.

The short descriptions and the introduction are models of *Precis* writing, giving in a page or two the history of potting in each country. There is a little confusion in the use of the terms "hard and soft." Hard paste is fired at a high temperature, and the glaze is fired at the heat at which the porcelain matures. Soft paste, on the other hand, is fired at a lower temperature, and the glaze at a still lower one. The terms hard and soft have nothing to do with the hardness and softness, as usually understood. So far as the body of the piece of ware is concerned, some hard paste may scratch with a file more easily than soft.

The Oriental section is particularly good. It displays very great care, and is a decided advance on anything of a similar kind that has been within the reach of an ordinary collector.

The scheme of the work takes the reader through the various countries, and the period covered extends from the Middle Ages to about 1850, with a selection of modern marks. It is a very great advantage to have the authors' assurance that none but undoubted marks are illustrated in the volume. Great care seem to have been taken with the dates also, but on page 33 the A. R., the cipher of Augustus of Poland, the patron of Bottger, is given by the author as 1725-40. Most authorities, and with reason, place this mark considerably earlier.

The Races of Man and their Distribution. By Dr. A. C. Haddon, F.R.S. Pp. x+126. (London: Milner and Company, Ltd., n.d.) Price 1s. net.

THIS book gives a description of the various races of mankind as complete as appears to be possible within the compass of a small volume. The physical characters and culture of each race are described as far as it is at present known, and the author has in many cases to confess that the knowledge is, as yet, very incomplete. In the general classification of mankind the character of the hair is taken as a